⑲ Europäisches Patentamt
European Patent Office
Office européen des brevets

⑪ Publication number: **0 615 401 A1**

⑫
EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC

㉑ Application number: **93919684.6**

(51) Int. Cl.⁵: **H05B 33/22**, H01S 3/18

㉒ Date of filing: **20.09.93**

(86) International application number:
PCT/JP93/01342

(87) International publication number:
WO 94/07344 (31.03.94 94/08)

㉚ Priority: **22.09.92 JP 252526/92**
18.03.93 JP 59145/93

㊸ Date of publication of application:
14.09.94 Bulletin 94/37

(84) Designated Contracting States:
DE FR GB NL

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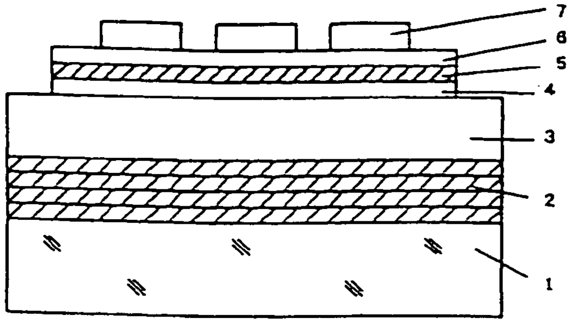
(54) ORGANIC LUMINESCENT ELEMENT AND ITS SUBSTRATE.

(57) An electro-optic transducing element used in the field of information communication. This element has a semi-transparent reflecting layer (2) on a transparent substrate (1), a transparent conductive layer (3) on the semi-transparent reflection layer (2), a luminescent layer (5) of an organic thin film on the transparent conductive layer (3), and electrodes (7) formed on the layer (5). The semi-transparent reflective layer (2) transmits a part of the light emitted by the luminescent layer (5) toward the transparent substrate (1), and reflects a part of the light toward the luminescent layer (5). The semi-transparent reflection layer (2) forms resonators together with the electrodes (7).

Fig. 1



BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an organic light emitting device available for display devices, light emitting devices for communications, information file reading/writing heads, printing apparatuses, and similar devices and apparatuses and to a substrate plate used for it.

Description of the Prior Art

Previously proposed organic light emitting devices include, for example, an organic electro-luminescent cell disclosed in the Japanese Patent Application Laid-Open No. 57-51781. The cell has a light emitting body of organic light emitting material and electrically insulating binder interposed between transparent substrates having transparent electrodes of indium tin oxide or the like and a compound layer of porphyrin system is formed between a positive one of the transparent electrodes and the light emitting body. The organic electro-luminescent cell has a hole injecting body of a compound of porphyrin system to inject holes on the basis of a signal voltage applied between the both electrodes to emit light.

Such light emitting devices having the organic thin film used therein are advantageous in fabrication at low cost. However, their use is limited to display panels as their half-widths of spectra are too wide. They also is available only for a single color of display as the specific material can emit only one color of light.

Object and Advantages

In view of solving the foregoing problems of the prior arts, it is an object of the present invention to provide an organic light emitting device having improved spectra width and light emitting characteristics.

Another object of the present invention is to provide a substrate plate used for organic light emitting device.

SUMMARY OF THE INVENTION

Briefly, the foregoing object is accomplished in accordance with aspects of the present invention by an organic light emitting device and a substrate plate used for it. The present invention features:

(1) An organic light emitting device, successively comprising a micro-resonator formed of a light emitting layer of organic thin film having a light emitting feature and reflective mirrors each of which is put on a surface of the light emitting layer, wherein the micro-resonator is devised to be capable of emitting a light.

(2) An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer put on the semi-transparent reflective layer, a light emitting layer of organic thin film put on the transparent conductive layer, and electrodes formed on the light emitting layer, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light omitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

(3) An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer put on the semi-transparent reflective layer, a hole injecting layer put on the transparent conductive layer, a light emitting layer formed of organic thin film put thereon, an electron injecting layer put thereon, and electrodes formed thereon, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light emitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

(4) The organic light emitting device described above, wherein an optical distance denoted by L between the semi-transparent reflective layer and the electrodes on back of the light emitting layer is given by an expression of

L = (integer - A/2@p) times, provided
$S < 2L < T$

where A is shift of phase of the light reflected between the semi-transparent reflective layer and the electrodes on back of the light emitting layer in radian, and S and T are wavelengths at which an intensity of the emitted light in a range of light emission spectra of a light emitting device having no semi-transparent reflective layer is one half of a peak intensity of the emitted light.

(5) The organic light emitting device described above, wherein an optical distance denoted by L between the semi-transparent reflective layer and the electrodes on back of the light emitting layer is

L = (0.9 to 1.1) x length of [(peak wavelength of light to be taken out) x (integer - A/2@p)/2]

where A is shift of phase of the light reflected between the semi-transparent reflective layer and the electrodes on back of the light emitting layer in radian, and S and T are wavelengths at which an intensity of the emitted light in a range of light emission spectra of a light emitting device having no semi-transparent reflective layer is one half of a peak intensity of the emitted light.

Also, similar effects of resonance can be obtained if the optical distance is times of integers, such as two times, three times, distance is times of half-integers, such as 1/2 times, 3/2 times,

(6) The organic light emitting device described above, wherein the semi-transparent reflective layer is formed of multi-film of dielectric material.

(7) The organic light emitting device described above, wherein sum of optical distances given in terms of products of thicknesses of the transparent conductive layer, the hole injecting layer, the light emitting layer, and the electron injecting layer multiplied by their respective refractive indexes is made equal or approximate to a peak wavelength of the emitted light.

(8) The organic light emitting device described above, wherein the semi-transparent reflective layer is formed of a total metal reflective film having a window opened for passing the emitted light out.

(9) The organic light emitting device described above, wherein a reflectance of the semi-transparent reflective layer is 50 to 99.9 % or a transmittance thereof is 50 to 0.1 %.

(10) A substrate plate for organic light emitting device, comprising a transparent substrate plate and a semi-transparent reflective layer of multi-film of dielectric material capable of transmitting parts of a light and reflecting parts of the light put on the transparent substrate plate, wherein a transparent conductive film is put on the semi-transparent reflective layer.

(11) A substrate plate for organic light emitting device, comprising a transparent substrate plate, a semi-transparent reflective layer of multi-film of dielectric material put on the transparent substrate plate, and a transparent conductive film put on the semi-transparent reflective layer, wherein a reflectance of the semi-transparent reflective layer is 50 to 99.9 % or a transmittance thereof is 50 to 0.1 %.

(12) A substrate plate for organic light emitting device, comprising a transparent substrate plate and a semi-transparent reflective layer having a transparent conductive film and a transparent insulating film laminated therein put on the transparent substrate plate, wherein the transparent conductive film is put on the semi-transparent reflective layer.

The substrate plate described above should be preferably formed of quartz, glass, or plastics and the semi-transparent reflective layer has the transparent conductive film patterned thereon.

In the organic light emitting device of the present invention, the light micro-resonator can be accomplished therein in the way that the semi-transparent reflective film is place between the transparent electrode and the substrate plate and the optical distance between the reflective film and the rear electrode is made equal to or integer times the emitted light wavelength. The micro-resonator can make narrow the half-width of the emitted light spectra. Also, the micro-resonator can increase the light emission efficiency, generate the coherent light, and improve the light emission characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a cross-sectional structure illustrating an organic light emitting device in a first embodiment of the present invention;

Fig. 2 is a cross-sectional structure illustrating a previous organic electroluminescent (EL) light emitting device;

Fig. 3 is a comparison graph illustrating light emission spectra of the devices in Figs. 1 and 2;

Fig. 4 is a graph illustrating a curve of the half-width of light emission spectra with respect to a resonating portion of a resonator of a light emitting device having a semi-transparent reflective film of the embodiment of the present invention;

Fig. 5 is a graph illustrating a curve of optical distance of the resonator with respect to a peak wavelength of the light emitted out of the device having the semi-transparent reflective film;

Fig. 6 is a cross-sectional structure illustrating a resonator device of emitting light by light excitation in a second embodiment of the present invention; and,

Fig. 7 is a graph illustrating light emission spectra of the device with respect to thickness of an organic fluorescent film of aluminum chelate compound.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The following describes in detail embodiments according to the present invention by reference to the accompanying drawings.

Embodiment 1

Fig. 1 depicts a cross-sectional structure illustrating an organic light emitting device in a first embodiment of the present invention.

The organic light emitting device has a glass substrate 1. The glass substrate 1 has a semi-transparent reflective film 2 laminated of a TiO_2 film and a SiO_2 film. On the semi-transparent reflective film 2 is formed a transparent conductive film 3 of indium tin oxide abbreviated ITO, a hole injecting layer 4 of triphenyl diamine derivative (TAD), a light emitting layer 5 of aluminum chelate compound, an electron injecting layer 6 of oxydiazole derivative (PBD), and electrodes 7 of Ag-Mg successively. Sum of optical distances obtained in terms of products of thicknesses of the transparent conductive film 3, the hole injecting layer 4, the light emitting layer 5, and electron injecting layer 6 multiplied by their respective refractive indexes should be made to coincide with 530 nm which is a peak wavelength at which the aluminum chelate compound makes electroluminescent (EL) light emission. This enables the resonator of present invention to function.

The hole injecting layer 4 and the electron injecting layer 6 as shown in Fig. 1 is not always needed if high performance characteristics are required. The organic light emitting device can be used without either or both of them. With the omission, holes are injected into the transparent conductive film 3, thereby completing the organic light emitting device. The device, however, should preferably have the hole injecting layer 4 and the electron injecting layer 6 provided therein.

Reflectance of the semi-transparent reflective film 2 should be selected with respect to performance characteristics of the light emitting layer 5 and application of the device. An upper limit of the device is restricted in terms of the energy that a light resonator can store without self-destruction. The reflectance is 50 to 99.9 % while transmissivity of the semi-transparent reflective film 2 is 50 to 0.1 %. To obtain an light emission of at least 10 @mW/cm^2, the transmissivity of the light to be fed out cannot be made lower than 0.1 %. The reflectance is limited to 99.9 %. If the reflectance is made too low, the light resonator cannot function. If it is lower than 50 %, the spectra width cannot be made sufficiently narrow.

The above-mentioned aluminum chelate compound used for the light emitting layer 5 may be alternatively replaced by perylene derivative, perinone derivative, naphthalene derivative, coumarin derivative, oxadiazole oxysadiazole, bisbensoxazoline, aldazine, pyrazine derivative, distilbenzine derivative, polyphenyl derivative, bisstilanthracene derivative, and chelate metal complex.

Any of the above-mentioned organic thin films can be formed by way of evaporation, coating, growing by chemical reaction, the Langmuir project method, or similar techniques. The thin films also can be formed of adequate mixtures of a plurality of organic materials.

Fig. 2 depicts a cross-sectional structure illustrating a previous organic electroluminescent (EL) light emitting device. This previous device is formed with the semi-transparent reflective film 2 removed from the structure shown in Fig 1.

Fig. 3 depicts a comparison graph illustrating light emission spectra of the devices in Figs. 1 and 2. We can see that a spectra curve A of the device of the present invention in Fig. 1 has narrower half-width than the previous device in Fig. 2. This is due to the fact that the semi-transparent reflective film 2 makes resonance of light emission in the device to generate an electromagnetic wave of a resonant frequency selectively. Such a light emission resonance provides effects that make narrow the half-width of the light emission spectra, increase a light emission efficiency, and generate an coherent light. The effects can be further increased by make the optical distance of a resonating portion of the resonator rather close to the light emission wavelength.

Fig. 4 depicts a graph illustrating a curve of the half-width of the light emission spectra with respect to the resonating portion of the resonator. The curve is the results obtained by a measurement of the device with only a thickness of the hole injecting layer 4 changed in the device structure in Fig. 1. In the graph, the half-width without the semi-transparent reflective film 2 is 100 %. We can see that the half-width is least around 530 nm at which the optical distance coincides with the peak wavelength, and becomes wide quickly as the wavelength is apart from 530 nm. We can also see from curve B in Fig. 3 that the device having no semi-transparent reflective film 2 has wavelengths of 480 and 580 nm when the light emission intensity is a half of that at 530 nm. This range corresponds to the one in which the half-width in Fig. 4 is made narrow.

Fig. 5 depicts a graph illustrating a curve of the optical distance of the resonator with respect to the peak wavelength of the light emitted out of the device having the semi-transparent reflective film 2. The resonance provides an effect of phenomenon that if the optical distance is deviated from 530 nm, the peak wavelength of the emitted light also is deviated from 530 nm. If the deviation is too large to cause light emission due to resonance, the peak of the whole light emission becomes close to the peak wavelength of 530 nm when the semi-transparent reflective film 2 is not provided.

We can see from the results in Fig. 5 that the resonance effect can be obtained when the optical distance is in a range of 0.9 to 1.1 times the peak wavelength of the emitted light. This range corresponds to the one in which the half-width in Fig. 4 is made narrow.

The aluminum chelate used as the material for the light emitting layer in the first embodiment may be alternatively replaced by not only compounds similar to that, but also any of mixtures, laminated layers, and similar organic materials that can emit light by way of electron-hole coupling.

It is important that the device should have an arrangement to keep the device temperature constant to stabilize the resonated light emission.

Optimum transmissivity and reflectance may vary depending on the device structure and the material forming the semi-transparent reflective film 2, but the absorptance should be preferably as close as to 0.

The semi-transparent reflective film 2 may be preferably replaced by a total metal reflective film having patterning processed and having a window opened partly for passing light out. Also, the device may be structure so hard to leak light laterally to increase the light emission characteristics further.

As described so far, embodiment 1 has the optical distance as resonator made to equal to the light emission wavelength. The embodiment, also, can theoretically provide similar effects of resonance if the optical distance is times of integers, such as two times, three times, ..., n times the light emission wavelength, and if the optical distance is times of half-integers, such as 1/2 times, 3/2 times, ..., n/2 times the light emission wavelength.

Also, embodiment 1 has the total light phase shift made 0 or 1 waveform by reflections on the upper and lower mirror surfaces. The embodiment, also, can make resonance for devices having the light shifted 1/2 wavelength on the metal surface and not shifted on the semi-transparent reflecting mirror if the optical length is made 1/4, 3/4, 5/4, and so times the light emission wavelength.

However, actual devices are involved in blunt sharpness of resonance due to fabrication of the devices themselves. The above-mentioned resonance effects therefore are keen as the film is thin, and the resonance is unclear as the number of times is large. For the reason, a practical number of times is limited to 10.

The device of structure in embodiment 1 can make field light emission by electric charge injection and also, can have a transparent substrate plate to irradiate a light to make the light emitting layer generate a fluorescent light, thereby producing spectra of light emission of narrow half-width similar to that of the field light emission. In such an example, it is possible for the device to omit the organic thin films other than the transparent electrodes and the light emitting layer.

Embodiment 2

Fig. 6 depicts a cross-sectional structure illustrating a resonator device of emitting light by light excitation in a second embodiment of the present invention.

The resonator device has an organic fluorescent thin film 9 of aluminum chelate compound put between a total metal reflective film 8 and a semi-transparent reflective film 2 laminated of a TiO_2 film and a SiO_2 film. A light of 406 nm wavelength is irradiated from the semi-transparent reflective film 2 to make the organic fluorescent thin film 9 emit a visible light.

Fig. 7 depicts a graph illustrating light emission spectra of the device with respect to thickness of the organic fluorescent thin film 9 of aluminum chelate compound. The thickness of the organic fluorescent thin film 9 of aluminum chelate compound can be changed to adjust position, half-width, and intensity of a peak of the emitted visible light. Also, a reflective characteristic of the semi-transparent reflective film 2 can be changed to adjust a form of the light emission spectra.

As described so far, the organic light emitting devices of the present invention provide such effects of light resonator as increasing the light emitting characteristics, including making narrow the half-width of light emission spectra, increasing the light emission efficiency, and generating the coherent light.

The organic light emitting devices of the present invention can alternatively replace the previous light emitting diodes and semiconductor diodes formed of GaAs, SiC, ZnSe, and similar inorganic semiconductors. They are available for optical communication devices, information display panels, reading/writing heads for optical record file, and optical heads for laser printer.

Claims

1. An organic light emitting device, successively comprising a micro-resonator formed of a light emitting layer of organic thin film having a light emitting feature and reflective mirrors each of which is put on a surface of the light emitting layer, wherein the micro-resonator is devised to be capable of emitting a light.

2. An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer

put on the semi-transparent reflective layer, a light emitting layer of organic thin film put on the transparent conductive layer, and electrodes formed on the light emitting layer, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light emitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

3. An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer put on the semi-transparent reflective layer, a hole injecting layer put on the transparent conductive layer, a light emitting layer formed of organic thin film put thereon, an electron injecting layer put thereon, and electrodes formed thereon, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light emitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

4. An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer put on the semi-transparent reflective layer, a hole injecting layer put the transparent conductive layer, a light emitting layer formed of organic thin film put thereon and electrodes formed thereon, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light emitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

5. An organic light emitting device, successively comprising a transparent substrate, a semi-transparent reflective layer put on the transparent substrate, a transparent conductive layer put on the semi-transparent reflective layer, a light emitting layer formed of organic thin film put on the transparent conductive layer, an electron injecting layer put thereon, and electrodes formed thereon, wherein the semi-transparent reflective layer is made to transmit parts of the light emitted by the light emitting layer to the transparent substrate and to reflect parts of the light to the light emitting layer, and the semi-transparent reflective layer and the electrodes on back of the light emitting layer are arranged together to act as an optical resonator.

6. The organic light emitting device according to any of claims 2 to 5, wherein an optical distance denoted by L between the semi-transparent reflective layer and the electrodes on back of the light emitting layer is given by an expression of

L = (integer - A/2@p) times, provided
S < 2L < T

where A is shift of phase of the light reflected between the semi-transparent reflective layer and the electrodes on back of the light emitting layer in radian, and S and T are wavelengths at which an intensity of the emitted light in a range of light emission spectra of a light emitting device having no semi-transparent reflective layer is one half of a peak intensity of the emitted light.

7. The organic light emitting device according to any of claims 2 to 5, wherein an optical distance between the semi-transparent reflective layer and the electrodes on back of the light emitting layer is 0.9 to 1.1 times or integer times a peak wavelength of a light to be taken out.

8. The organic light emitting device according to any of claims 2 to 5, wherein an optical distance denoted by L between the semi-transparent reflective layer and the electrodes on back of the light emitting layer is

L = (0.9 to 1.1) x length of [(peak wavelength of light to be taken out) x (integer - A/2@p)/2]

where A is shift of phase of the light reflected between the semi-transparent reflective layer and the electrodes on back of the light emitting layer in radian, and S and T are wavelengths at which an intensity of the emitted light in a range of light emission spectra of a light emitting device having no semi-transparent reflective layer is one half of a peak intensity of the emitted light.

9. The organic light emitting device according to claim 3, wherein sum of optical distances given in terms of products of thicknesses of the

transparent conductive layer, the hole injecting layer, the light emitting layer, and the electron injecting layer multiplied by their respective refractive indexes is made equal or approximate to a peak wavelength of the emitted light.

10. The organic light emitting device according to any of claims 2 to 5, wherein the semi-transparent reflective layer is formed of multi-film of dielectric material.

11. The organic light emitting device according to any of claims 2 to 9, wherein the semi-transparent reflective layer is formed of a total metal reflective film having a window opened for passing the emitted light out.

12. The organic light emitting device according to any of claims 2 to 10, wherein a reflectance of the semi-transparent reflective layer is 50 to 99.9 % or a transmittance thereof is 50 to 0.1 %.

13. A substrate plate for organic light emitting device, comprising a transparent substrate plate and a semi-transparent reflective layer of multi-film of dielectric material capable of transmitting parts of a light and reflecting parts of the light put on the transparent substrate plate, wherein a transparent conductive film is put on the semi-transparent reflective layer.

14. A substrate plate for organic light emitting device, Comprising a transparent substrate plate, a semi-transparent reflective layer of multi-film of dielectric material put on the transparent substrate plate, and a transparent conductive film put on the semi-transparent reflective layer, wherein a reflectance of the semi-transparent reflective layer is 50 to 99.9 % or a transmittance thereof is 50 to 0.1 %.

15. A substrate plate for organic light emitting device, comprising a transparent substrate plate and a semi-transparent reflective layer having a transparent conductive film and a transparent insulating film laminated therein put on the transparent substrate plate, wherein the transparent conductive film is put on the semi-transparent reflective layer.

16. The substrate plate for organic light emitting device according to any of claims 13 to 15, wherein the transparent substrate plate is formed of quartz, glass, or plastics and the semi-transparent reflective layer has the transparent conductive film patterned thereon.

Fig. 1

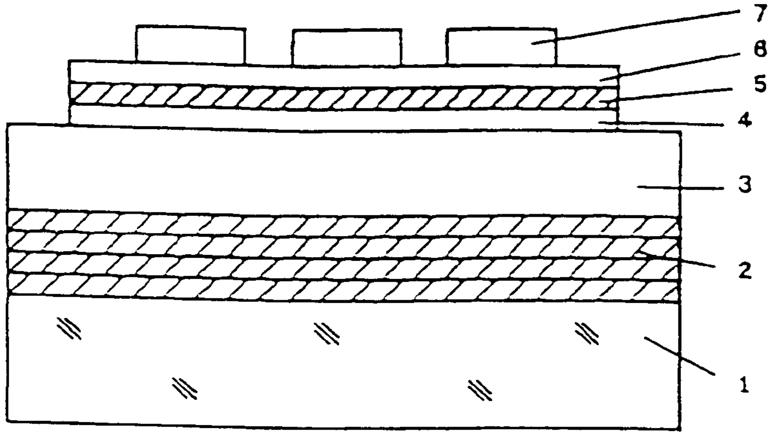


Fig. 2

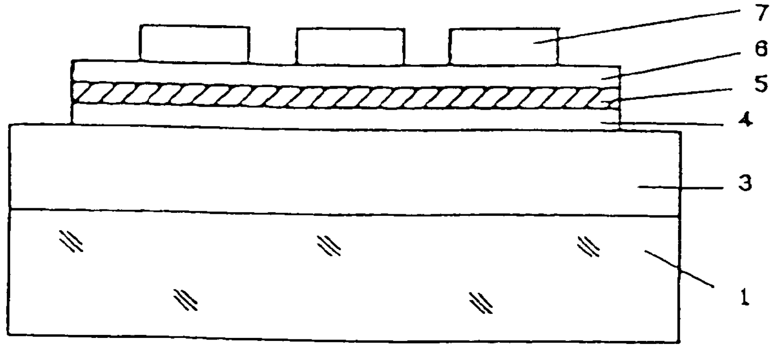


Fig. 3

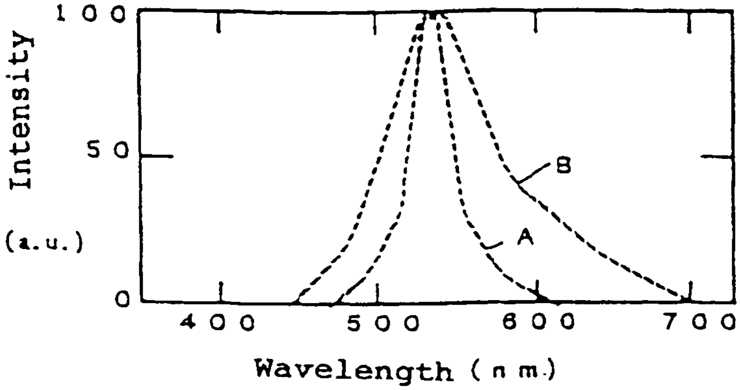

Intensity
(a.u.)
100
50
0
400
500
600
700
Wavelength (nm)
A
B

Fig. 4

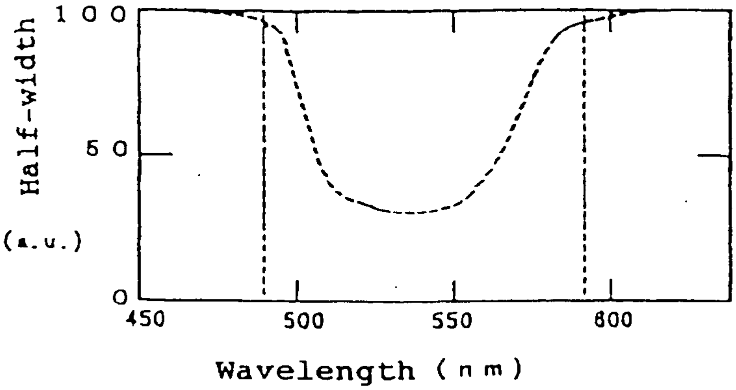

Half-width
(a.u.)
100
50
0
450
500
550
600
Wavelength (nm)

Fig. 5

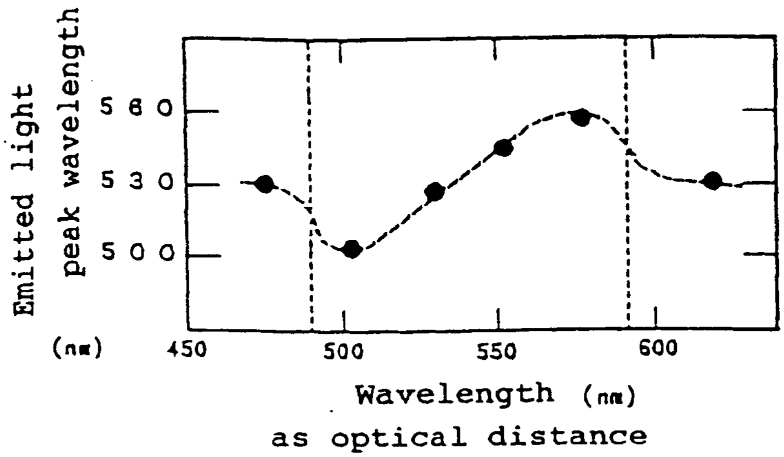

Emitted light
peak wavelength
(nm)
560
530
500
450
500
550
600
Wavelength (nm)
as optical distance

Fig. 6

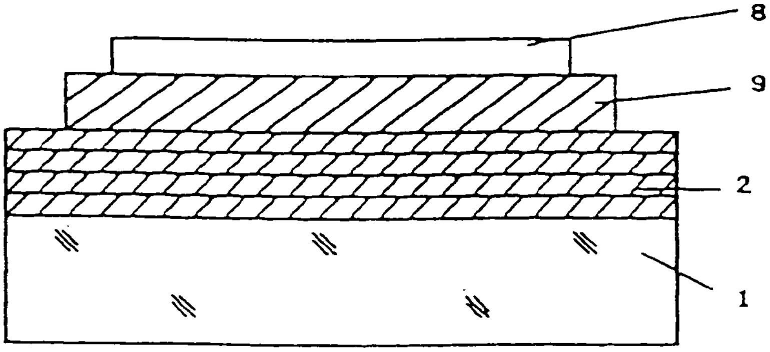
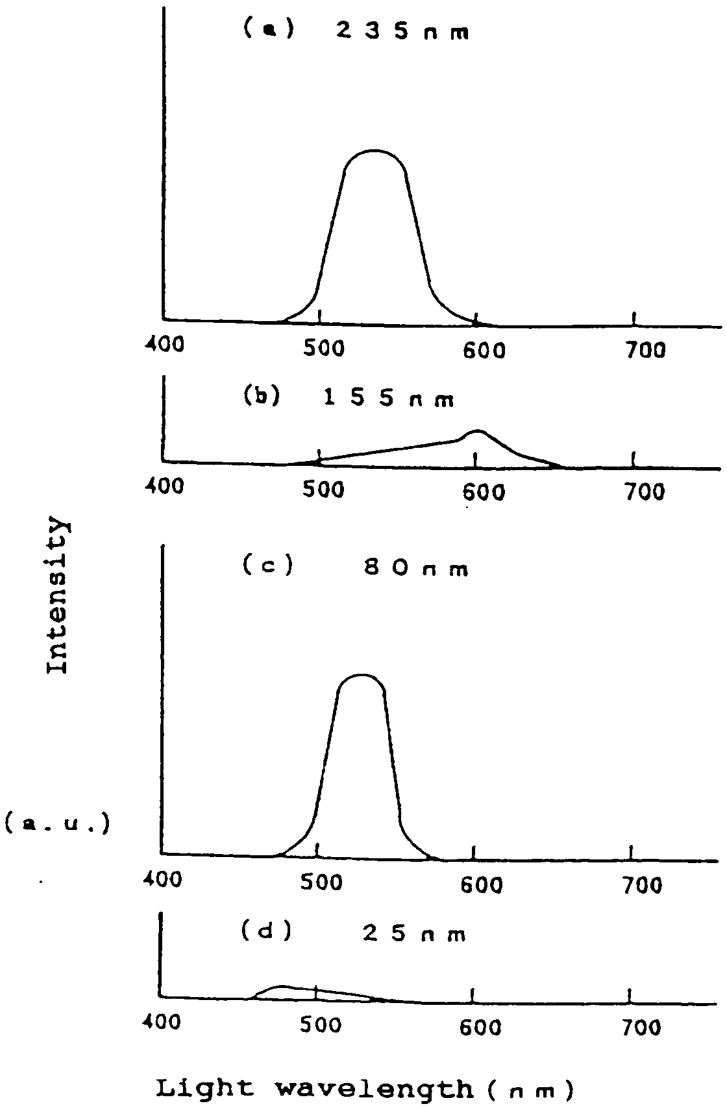

8
9
2
1

Fig. 7


(a) 235nm
400
500
600
700
(b) 155nm
400
500
600
700
Intensity
(a.u.)
(c) 80nm
400
500
600
700
(d) 25nm
400
500
600
700
Light wavelength (nm)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP93/01342

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^5 H05B33/22, H01S3/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^5 H05B33/22-33/28, H01S3/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926 - 1993
Kokai Jitsuyo Shinan Koho	1971 - 1993

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, A, 2-46695 (Matsushita Electric Ind. Co., Ltd.), February 16, 1990 (16. 02. 90), (Family: none)	1-16
Y	JP, U, 3-69899 (Toyota Motor Corp.), July 11, 1991 (11. 07. 91), (Family: none)	1-16
Y	JP, A, 3-187186 (Matsushita Electric Ind. Co., Ltd.), August 15, 1991 (15. 08. 91), (Family: none)	6-9
Y	JP, A, 4-109589 (Toshiba Corp.), April 10, 1992 (10. 04. 92), Figs. 1, 3 (Family: none)	3, 4, 9
Y	JP, A, 1-130495 (Nippon Telegraph & Telephone Corp.), May 23, 1989 (23. 05. 89), Lines 11 to 16, upper right column, page 2, Fig. 1 (Family: none)	3, 5, 9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search December 14, 1993 (14. 12. 93)	Date of mailing of the international search report January 6, 1994 (06. 01. 94)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP93/01342

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, A, 4-237993 (Idemitsu Kosan Co., Ltd.), August 26, 1992 (26. 08. 92), Lines 2 to 10, column 1, Fig. 4 (Family: none)	3, 9
Y	JP, A, 2-12795 (NEC Corp.), January 17, 1990 (17. 01. 90), Figs. 4, 5 (Family: none)	4, 5
Y	JP, A, 2-78280 (Ricoh Co., Ltd.), March 19, 1990 (19. 03. 90), Line 12, upper right column to line 13, lower left column, page 3, Fig. 1 & US, A, 4990972	11
Y	JP, A, 1-236672 (Seiko Epson Corp.), September 21, 1989 (21. 09. 89), Line 10, upper right column to line 5, lower left column, page 2, Fig. 1 (Family: none)	10, 13, 14

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